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Study of Early After Depolarization in a Complex Human Cardiac Cell Model in Tissue

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Abstract

Early After Depolarization (EAD) activations are considered one of the mechanisms in which some of the most dangerous arrhythmias are initiated in the heart. Experimentally, some drugs have been shown to induce EADs. However, little is known about how they initiate and specially how they propagate in tissue. In this study, we use one of the most updated cardiac ionic models, namely O'Hara-Ruddy model, which consist of over 35 nonlinear ordinary differential equations per cardiac cell to investigate the initiation of EADs as a function variability in the ionic channels dynamics from single cell to tissue. To be able to study this cardiac model in space, we use our in-house developed WebGL library to accelerate simulations with Graphical Processing Units (GPU). We show how coupling effects in space can change the behavior of EADs, spiral waves, and complex spatio-temporal patterns resembling fibrillation.